

NONGAME WILDLIFE COMMUNITIES IN GRAZED AND UNGRAZED MONTANE RIPARIAN SITES

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The riparian zone is an important habitat type for wildlife, providing numerous foraging and breeding sites (Thomas et al. 1979b). Greater numbers and diversity of nongame wildlife have been found in riparian areas when compared with upland habitats for birds in Colorado (Knopf 1985) and small mammals in Oregon (Cross 1985). Fifty percent of the nesting bird species in the Southwest (Johnson et al. 1977) and 82% of those in northern Colorado (Knopf 1985) occur in riparian habitats. The high density and species diversity of wildlife in riparian areas have been attributed to the many structural layers of riparian vegetation and to its ecotonal nature (Thomas et al. 1979a).

Livestock grazing can alter vegetative structure and composition of riparian habitat. Ryder (1980) stated that grazing, especially by livestock and big game, frequently changes plant species composition and growth form, density of stands, vigor and seed production of plants, and insect production. Bull and Skovlin (1982) attributed to livestock grazing the paucity of deciduous woody vegetation that was required by some bird species along Oregon streams. Annual livestock grazing depressed the numbers of all small mammal species observed at Malheur National Wildlife Refuge in Oregon (Cornely et al. 1983). Small mammal species richness and diversity was higher in 11-year-old exclosures in Nevada than in adjacent riparian areas grazed by cattle (Medin and Clary 1989).

This study was designed to determine the effects of season-long cattle grazing on nongame wildlife communities in a montane

riparian zone in north central Colorado. Most research on the effects of livestock grazing on riparian bird communities has been conducted in the arid southwestern United States, and little is known about the effects of livestock grazing on birds or small mammals in more mesic environments.

STUDY AREA AND METHODS

This study was conducted within the riparian zone bordering Sheep Creek, 75 km northwest of Fort Collins, Colorado, in the Roosevelt National Forest, at approximately 2500 m elevation. Sheep Creek varies from 3 to 4 m in width, with a riparian zone 25-75 m wide.

According to USDA Forest Service records, the Sheep Creek Grazing Allotment received extremely heavy cattle grazing pressure until the 1950s. By the late 1940s, the entire riparian area was practically denuded, with little herbaceous plant cover and only a few remnant willow (*Salix* spp.) stumps remaining. The Forest Service and Colorado Division of Wildlife built two exclosures in the fall of 1956 to protect the riparian area from livestock overgrazing in an effort to improve the fisheries habitat. A third exclosure was constructed in the spring of 1959. The three exclosures protect a total of 40 ha of the riparian zone and 2.5 km of stream. Fences consisting of three-strand barbed wire were designed to restrict only livestock access to the riparian zone. Exclosures and grazed areas were interspersed along a 5-km section of Sheep Creek (Fig. 1).

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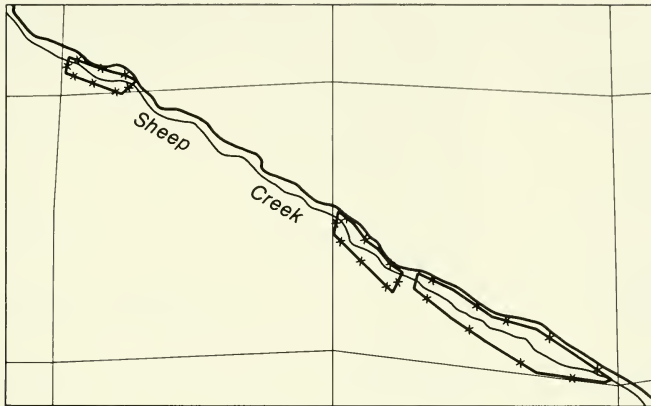


Fig. 1. Map of study area showing the Sheep Creek enclosures and adjacent grazed areas. Enclosures encompassing 40 ha of the riparian zone and 2.5 km of stream were constructed in the 1950s to protect the riparian area from overgrazing by domestic livestock. The Forest Service road that runs along the north side of the stream is shown on this map, as well as section lines for an indication of spatial scale (approximately 1 mi).

Stocking rates in the Sheep Creek Allotment have been reduced from nearly 1900 animal unit months (AUMs) in 1939 to 600 AUMs presently in the grazed area (unpublished data on file at USDA Forest Service). The allotment carrying capacity is estimated at 621 AUMs. Cattle graze the Sheep Creek Allotment season-long from approximately mid-June until mid-October. Utilization of forage by livestock was estimated from clipping vegetation at the end of the grazing season under protected cages and adjacent paired grazed plots. Cattle consumption of the current year's growth in the riparian area was 65% in both 1985 and 1986 (Schulz and Leininger 1990).

Streambank vegetation inside the enclosures is dominated by planeleaf willow (*Salix planifolia*), grasses and grasslike plants, including fowl bluegrass (*Poa palustris*), and rushes (*Juncus* spp.). Vegetation in grazed areas is composed predominantly of herbaceous species, including Kentucky bluegrass (*P. pratensis*), upland sedges (*Carex* spp.), beaked sedge (*C. rostrata*), white clover (*Trifolium repens*), and dandelion (*Taraxacum officinale*). In 1985 and 1986 total vascular vegetation cover, graminoid cover, and shrub cover in the enclosures were greater than in grazed areas (Schulz and Leininger 1990).

The Sheep Creek enclosures had nearly twice the litter buildup, and willow canopy coverage was 8.5 times greater than in grazed areas (Schulz and Leininger 1990). Upland vegetation consists of ponderosa pine (*Pinus ponderosa*) with sparse understory on north-facing slopes and big sagebrush (*Artemisia tridentata*) on south-facing slopes. Aspen (*Populus tremuloides*) is also common in more mesic areas.

Strip transects for an index of bird abundance were conducted during May–June 1986 in the enclosures and adjacent grazed areas following methods described by Verner (1985). Transects were 20 m wide and 100 m long parallel to the stream channel. Transect width ensured that all observations fell within the riparian zone. Fourteen transects (7 within the grazed areas and 7 in the enclosures) were censused 10 times during the two-month period. Counts were made between 0630 and 1000 when birds are most active and vocal. Locations of birds were marked on data forms as we walked through the middle of each transect.

Twelve snap-trap transect lines for capturing small mammals were established parallel to the stream channel (6 inside enclosures and 6 in the grazed areas). Transect lines were 114 m in length with 20 stations, one every

TABLE 1. Total bird observations on 14 strip transects in grazed and ungrazed montane riparian sites May-June 1986.

Bird species	Scientific name	Grazed	Exlosures
American Robin	<i>Turdus migratorius</i>	35	15
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	1	2
Brown-headed Cowbird	<i>Molothrus ater</i>	4	0
Cassin's Finch	<i>Carpodacus cassinii</i>	1	2
Chipping Sparrow	<i>Spizella passerina</i>	3	5
Clark's Nutcracker	<i>Nucifraga columbiana</i>	2	0
Dark-eyed Junco	<i>Junco hyemalis</i>	7	9
<i>Empidonax</i> Flycatcher	<i>Empidonax</i> spp.	3	2
House Wren	<i>Troglodytes aedon</i>	1	0
Killdeer	<i>Charadrius vociferus</i>	1	0
Lincoln's Sparrow	<i>Melospiza lincolni</i>	4	13
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	1	0
Mountain Chickadee	<i>Parus gambeli</i>	8	17
Mountain Bluebird	<i>Sialia currucoides</i>	2	0
Northern Flicker	<i>Colaptes auratus</i>	0	1
Pine Siskin	<i>Carduelis pinus</i>	1	0
Ruby-crowned Kinglet	<i>Regulus calendula</i>	8	8
Tree Swallow	<i>Tachycineta bicolor</i>	2	0
Warbling Vireo	<i>Vireo gilvus</i>	2	0
Western Tanager	<i>Piranga ludoviciana</i>	1	2
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	1	5
Wilson's Warbler	<i>Wilsonia pusilla</i>	0	9 ¹
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	4	0
Yellow-rumped Warbler	<i>Dendroica coronata</i>	0	2
Number of individuals		92	92

¹Difference between treatments was significant at the .05 level.

6 m, following Johnson (1982). The starting point of each transect line was randomly located between 10 and 20 m from the fence-line. Two Museum Special snap-traps were baited with peanut butter and set at each station. Traps were checked and reset every morning and evening at dusk. Transect lines were run for four days and nights in late July through August 1986 for a total of 1920 trap nights. Pitfall traps were also set for capturing shrews. Since trends in shrew abundance from pitfall traps were consistent with the snap-trap data, only snap-trap data is reported. All collected specimens were frozen and later identified by U.S. Fish and Wildlife Service museum personnel in Fort Collins. Shrews were identified following the key of Junge and Hoffmann (1981).

Paired *t* tests were used to compare total numbers of individuals of each bird and small mammal species by transect between grazed areas and exclosures. Homogeneity of variances was tested using Bartlett's test (Sokal and Rohlf 1981). Simpson's index of diversity (Simpson 1949) was calculated for exclosures and grazed areas using bird survey and small mammal snap-trap data. Since two communities can have the same index of diversity but

have no species in common (Samson and Knopf 1982), Morisita's index of community overlap was also calculated. Morisita's index can be interpreted as the probability of randomly drawing two individuals from two populations (i.e., grazed areas and exclosures) that both belong to the same species, relative to the probability of randomly drawing two individuals of the same species from either of the populations alone (Horn 1966).

RESULTS

Twenty-one bird species were observed in the grazed transects, whereas 14 species were seen in the exclosures (Table 1). Eleven bird species were found in both areas. Total numbers of bird sightings were the same in both the grazed areas and the exclosures, with 92 observations. The American Robin (*Turdus migratorius*), with 35 sightings, was the most abundant species in the grazed areas, while the Mountain Chickadee (*Parus gambeli*), with 17 sightings, was the most common species in the exclosures (Table 1).

Wilson's Warbler (*Wilsonia pusilla*) was significantly more abundant ($P = .02$) in the exclosure transects. Lincoln's Sparrow

TABLE 2. Total small mammals captured with Museum Special snap-traps (number of trap nights = 1920) in grazed and ungrazed montane riparian sites July–August 1986.

Mammal species	Scientific name	Grazed	Exclosures
Deer mouse	<i>Peromyscus maniculatus</i>	15	1 ^a
Golden-mantled ground squirrel	<i>Citellus lateralis</i>	1	0
Least chipmunk	<i>Eutamias minimus</i>	5	2
Longtail vole	<i>Microtus longicaudus</i>	0	1
Masked shrew	<i>Sorex cinereus</i>	4	5
Montane shrew	<i>S. monticolus</i>	1	9
Mountain vole	<i>M. montanus</i>	0	1
Northern pocket gopher	<i>Thomomys talpoides</i>	1	0
Western jumping mouse	<i>Zapus princeps</i>	1	22 ^b
Total		28	41

^aDifferences between treatments were significant at the .05 level.

^bDifferences between treatments were significant at the .01 level.

(*Melospiza lincolni*) ($P = .12$) also tended to be more abundant in the exclosures. Other species, e.g., Dark-eyed Junco (*Junco hyemalis*) and Ruby-crowned Kinglet (*Regulus calendula*), were equally common in grazed and ungrazed areas (Table 1).

Seven small mammal species were captured in the grazed areas, and an equal number were trapped in the exclosures (Table 2). Five small mammal species were common to both the grazed and ungrazed areas. Twenty-eight individual small mammals were trapped in the grazed area, compared with 41 in the exclosures (Table 2). The deer mouse (*Peromyscus maniculatus*), the most abundant small mammal species in the grazed area, was caught more often in the grazed areas than in the exclosures ($P = .04$). In contrast, the western jumping mouse (*Zapus princeps*), the most abundant species in the exclosures, was caught more often in the exclosures than in the grazed areas ($P = .006$) (Table 2). Other species such as the masked shrew (*Sorex cinereus*) appeared unaffected ($P > .25$) by cattle grazing (Table 2).

Simpson's diversity index for birds and small mammals was similar for the grazed areas and the exclosures (Table 3). Morisita's index of overlap was low for both taxa, based on the similarity of the communities in grazed areas and exclosures (Table 3).

DISCUSSION

Breeding Birds

Bird species are differentially affected by cattle grazing in riparian areas. Mosconi and Hutto (1982) showed that some riparian bird species, such as American Robin, benefit from

TABLE 3. Comparison of nongame community parameters between grazed and ungrazed riparian sites.

Treatment	Species richness	Diversity index	Overlap
BIRD COMMUNITIES			
Grazed areas	21	0.83	
Exclosures	14	0.89	15%
SMALL MAMMAL COMMUNITIES			
Grazed areas	7	0.68	
Exclosures	7	0.66	19%

grazing, while others are negatively affected. Robins forage in short grassy areas (Bent 1949), which are more abundant in grazed areas along Sheep Creek than in the exclosures (Schulz and Leininger 1990).

Both Wilson's Warbler and Lincoln's Sparrow were common in ungrazed areas with abundant willows. Wilson's Warbler breeds in willow thickets along mountain streams (Bent 1953), while Lincoln's Sparrow prefers brushy vegetation with an understory of grasses and sedges (Bent 1968). The greater shrub coverage in the exclosures (Schulz and Leininger 1990) probably accounts for the observed differences in abundance of these two species. While small sample size is a concern in this study, other more extensive studies support these findings. In southeastern Wyoming, Lincoln's Sparrow and Wilson's Warbler dominate subalpine willow communities (Finch 1986).

Rucks (1978) stated that livestock grazing causes the replacement of shrub-nesting bird species with species showing no preference for vertical vegetation structure. Riparian

areas dominated by planeleaf willow in south-eastern Wyoming contain a unique, but depauperate, assemblage of bird species (Finch 1988). Our study supports the above findings. Wilson's Warbler and Lincoln's Sparrow appear to have been replaced by ubiquitous species such as American Robin in grazed areas along Sheep Creek.

Small Mammals

Patton (1977) stated that small rodents are probably the least understood and documented group of animals using the riparian habitat. Johnson (1982) felt that grazing increases the density of those small mammal species that require low levels of cover, while subsequently reducing the density of those requiring higher levels of cover. Our study agrees with earlier studies showing that the deer mouse is more abundant under grazed conditions (Black 1968, Johnson 1982).

In this study, the western jumping mouse was more abundant in the exclosures than in the grazed areas. According to Clark's (1971) study in western Wyoming, the western jumping mouse prefers moderately wet aspen and shrub-sedge savanna habitats within 100 m of water. This type habitat is more characteristic inside the exclosures than in grazed areas along Sheep Creek (Schulz and Leininger 1990). Our data support Cranford's (1983) suggestion that the quality and type of vegetation is more important in determining suitable habitat for the western jumping mouse than the availability of water.

While sampling only one year is a concern in this study, small mammal snap-trapping a second year would have sampled a replacement, not a stable, community. This replacement community may or may not have had the same species composition as the stable community.

Diversity Patterns

The three levels of diversity, within habitat, between habitat, and regional, are parameters used to describe wildlife communities. Within-habitat diversity refers to the number of species within an area of uniform vegetation structure (Noss 1983) such as the Sheep Creek exclosures. Between-habitat diversity reflects the differences seen between habitats such as the entire riparian zone (grazed and ungrazed areas combined). Regional diversity refers to the diversity across the landscape (Noss 1983).

Simpson's diversity index indicated similar levels of diversity in the nongame communities in grazed areas and exclosures. This measure of within-habitat diversity reflects the number and abundance of species populations within a habitat type (Samson and Knopf 1982). Morisita's index of overlap was quite low, suggesting that, although the nongame communities in grazed areas and exclosures have a similar level of diversity, they are quite different in species composition. This value indicates a high between-habitat diversity across the entire riparian zone. Livestock grazing appears to change habitat structure (Schulz and Leininger 1990), resulting in a shift in species composition of birds and small mammals in the montane riparian zone, while maintaining the level of diversity. Riparian areas that contain unique species such as Wilson's Warbler are important contributors to regional diversity of the forest.

Management Considerations

Riparian zones can be managed for nongame species richness by maintaining high structural diversity of vegetation. While the number of nongame species is important, managers should also use value judgments on the worth of individual species (Balda 1975). Thus, management should not maximize the numbers of two common species such as American Robin and Brown-headed Cowbird at the expense of one sensitive species such as Wilson's Warbler. Species such as Wilson's Warbler, Lincoln's Sparrow, and western jumping mouse that are sensitive to grazing pressure should be monitored as indicators of habitat change. Johnson (1982) pointed out the need to coordinate range and wildlife habitat management to ensure the existence of sensitive wildlife species that are negatively impacted by livestock grazing.

This study suggests that previous heavy cattle grazing changed the bird and small mammal community composition through reduction of shrub and herbaceous cover. More research should be done to determine the effects of different season-long intensities of grazing as well as different seasons of grazing on nongame wildlife communities.

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